THESE ARE YOUR WEAPONS

FOURTEEN WAYS TO INCREASE YOUR WAR PRODUCTION -

HOWELL N. WHITE, JR. • METHODS DEPARTMENT • PLOMB TOOL CO.
TREVOR GARDNER • METHODS CONSULTANT • PLOMB TOOL CO.

PLOMB TOOL COMPANY
LOS ANGELES

D·E·D·I·C·A·T·I·O·N

This book is dedicated to the workers on the American production front. It is hoped that it will excite the imaginations of the members of our industrial army to do their own particular tasks in the

ONE BEST WAY

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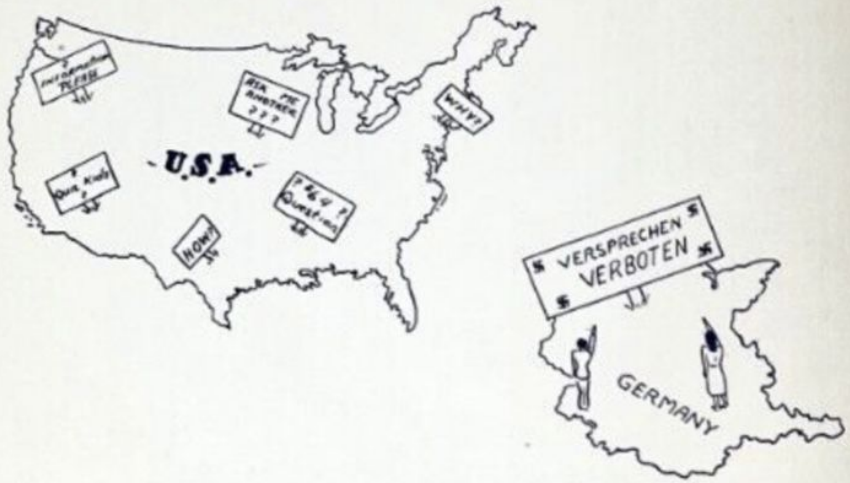
Sketches by BIRDINE OVERTON • Traffic Department

Photographs by JACK O'BRIEN • Steel Foreman

PLOMB TOOL COMPANY

LOS ANGELES

THESE ARE YOUR WEAPONS



America's greatest weapons are not secret, but our enemies have no conception of their power. Even we have not as yet realized their limitless possibilities.

Our basic weapons are the talents of free men to work their utmost with their brains, as well as with their hands—a right denied by Hitler and by Hirohito to their subjects. To think is to question, and in the German Reich to question is to commit a crime against the Fuehrer. In America, to question is our privilege and our duty.

The Questioning Attitude

America has never mistaken the time-worn for the time-tried; we have never been afraid to ask questions—"How?" "Why?" and "Why Not?" America was discovered as a result of one man's refusal to accept the belief that the earth was flat. Columbus' *questioning attitude* led him to the most momentous discovery of modern times.

We as a nation have inherited that attitude. Our national talent for intelligent skepticism—for asking the right questions—has made us great. Our *questioning attitude* has forced us on to new frontiers of science, of government, and of industry. It has led us to develop better ways of making life easier and more plentiful, and now it is driving us to find swifter and better ways of manufacturing the planes, tanks, guns, and tools of war.

The Production Front

Germany and Japan began to prepare for this war twenty years ago. Their factories were producing planes by the thousands—while we were making them by the hundreds; their armies were fighting with tanks and guns — while we were drilling with wooden rifles. Both nations, by adapting American mass production methods to the manufacture of armaments, believed that they had so far outstripped us that our defeat was certain.

They were wrong. In two years, we have caught up to their fifteen years of war production. But before we can win our final victory we must out-produce them two for one. We must double our production once again.

The One Best Way

One fact about the job ahead is a direct challenge to every worker. Each of us could add one full hour to our day's production by questioning and improving our everyday jobs. Could our workplace be re-arranged? Could our tooling be simplified or improved? Are our motions awkward or fatiguing?

There is One Best Way to do every job. Perhaps we have already found it, but more probably we have not, for there is a strange quirk in human nature that makes most of us choose the hard way. Often a headache, a crick in the neck, or an aching back is a sign that we have been making our job more difficult than necessary.

The Laws of Work

There are fourteen Laws of Work that may be applied to every job, whether it is firing a torpedo, operating a machine, or assembling two safety pins, one diaper and one baby. By applying them to our jobs each one of us could produce more work with less fatigue.

In the following pages these Laws of Work are presented in the form of easy tests. Read them, check your answers, and then turn to the Score Sheet on page 30. Have you already found the *One Best Way* to do *your* job?

HAS MY JOB GOT RHYTHM?

YES ☐

NO ☐

Fatigue is reduced and production is increased when work is performed in the natural rhythm of the job.

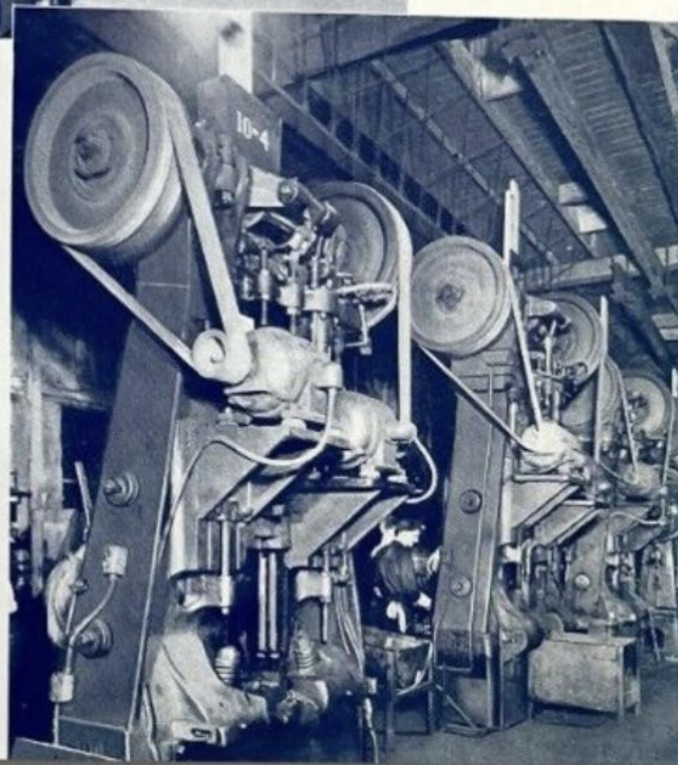
Some jobs force their natural rhythm upon us. The rhythmic pounding of the drop hammers imposes itself on the whole Forge Shop. Other jobs may have a less noticeable rhythm, but even a drill press operation or a simple bench assembly has its own characteristic pattern. A skilled worker who has the "feel" of his job is like a trained athlete whose sense of "timing" makes every move seem effortless. A top-flight golfer will send a drive three hundred yards down the fairway with a rhythmic, easy swing; but a dub will make hard work of a hundred-yard shot.

There is often a similar difference between two operators at the same job on identical machines. One may work along at a steady pace that looks deceptively slow, but we can sense his speed from the rhythm of his movements. The other man may seem to be working faster, but we can tell from his short jerky motions that he is not getting anywhere; he is working like an automobile trying to climb Pike's Peak with a slipping clutch.

Finding the rhythm of our jobs is nothing that can be taught by others, or even something to be learned by conscious effort. It is, instead, the product of the way we work and our alertness to the rhythmic pattern of our jobs. One useful trick that helps is to listen

to the sounds of the work itself—the dropping of the tools into the tub—the hum of the machine—and to fit these sounds into a wordless song. Once we have learned this rhythmic tune and can follow its beat like a good dancer, it will carry us along at a faster pace with less fatigue.

...Drill presses have a characteristic pattern.



...The rhythmic pounding of drop hammers.

IS MY JOB SET UP FOR DROP DELIVERY?

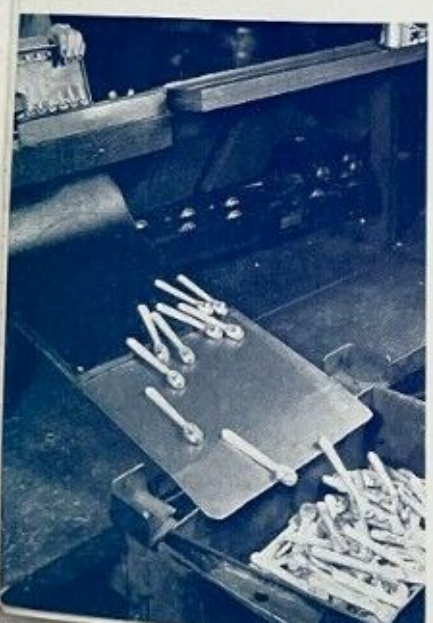
YES ☐

NO ☐

The quickest way to get rid of a completed part is to drop it.

Drop delivery of bombs and paratroops to Tokio and Berlin can be speeded up by use of *drop delivery* at our machine or workbench. When we have finished working on a part, we save production hours by dropping the completed work directly into tub or pan.

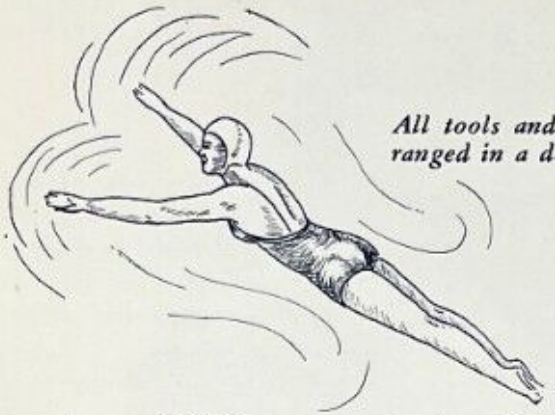
Examples of the ideal *drop delivery* set-up are the presses in the Machine Shop and in the Forge Shop which drop blanks and trimmed forgings directly through the die without handling. In the Assembly Department a good example may be seen on the Wright Field ratchet assembly bench. When the last screw has been driven home, a catch is released and the assembled ratchets tumble onto a chute and slide into a waiting tub. Use of this simple device has added twelve more working days to the year's production of ratchets.



Drop delivery of assembled Wright Field ratchets.

Even in those cases where the simplest *drop delivery* might dent or mar the finish on the tools, some form of chute could be designed to break the fall. A soft canvas tube, flexible baffles, or a simple conveyor might solve this problem.

IS MY WORK LAID OUT IN MY NORMAL WORKING AREA?



YES ☐

NO ☐

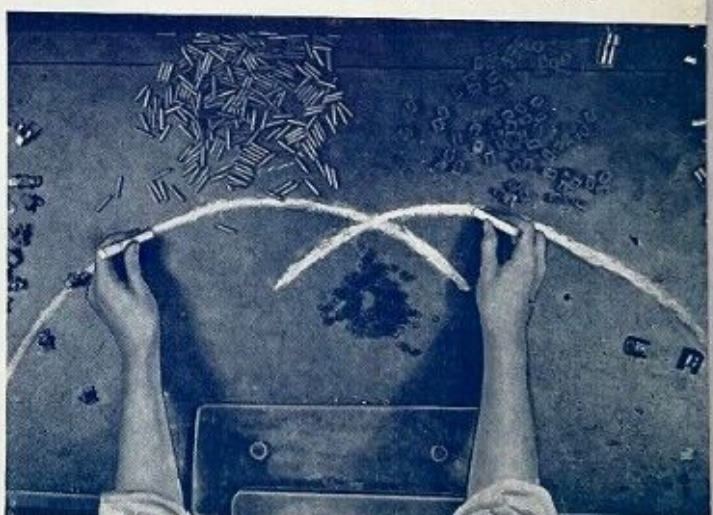
All tools and materials should be arranged in a double circle before us.

The simple matter of the arrangement of our workplace can sometimes add 50% to our production. If we must reach and stretch and look and fumble for the parts of a small assembly, we tire ourselves out and slow ourselves down unnecessarily.

The first thing to do is to bring all parts within easy reach—into what is called the *normal working area.* The circular sweep of the arms of a girl swimming the breast stroke will give us the ideal pattern of workplace arrangement.

No two of us have the same *normal working area,* since it is determined by the length of our arms. To find out what our own *normal working area* is, we can take a grease pencil, or a piece of chalk, in each hand, and draw two circles on the bench before us, as in the photograph. If we have drawn these circles without reaching or stretching, we can save ourselves time and fatigue by bringing all our tools and materials inside the circles.

On machine jobs as well, we should arrange our workplace, if possible, in this double-circle pattern around us.



CAN MY JOB PASS THE BALANCED MOTION TEST?

YES ☐

NO ☐

Motions of the hands and arms should be made at the same time—in opposite directions.

For the same reason that it is easier to carry two pails of water balanced on a shoulder yoke than it is to carry one pail, the easiest way to work is to let our motions balance one another. Often we do this naturally—when we walk briskly we swing our arms, the right arm balances the left foot; the left arm balances the right foot. But in most cases we must train ourselves to use balanced motions. It usually takes a day or two to learn this work pattern, but once we have mastered it we can do up to 50% more work with less fatigue.

A case in point is the job of assembling universals. The assembly consists of seven parts: One female, one male, one block, two lock washers, and two pins. The assembly fixture was designed to permit the use of balanced motions of both hands, as shown in the strip of movie film. The job begins like this: (1) Get two females, one in each hand; (2) Place females on fixture; (3) Get two males, one in each hand; (4) Place males in fixture.

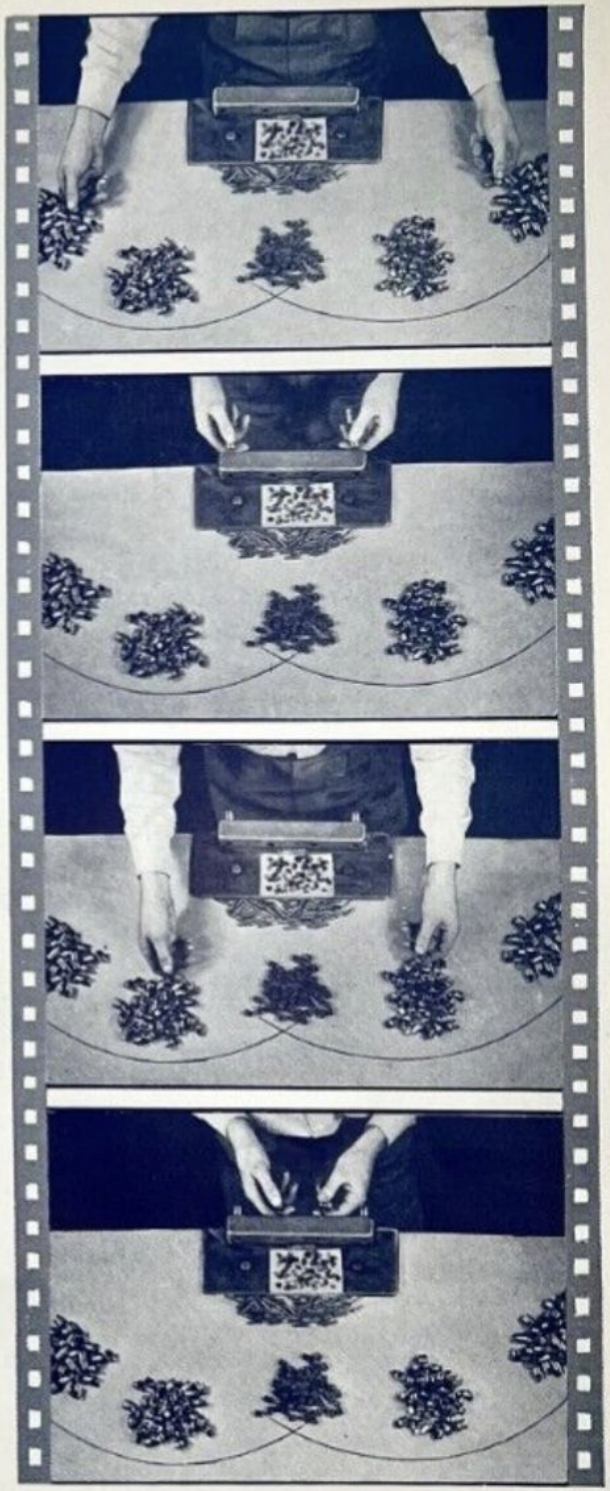
New operators, unfamiliar with this work-pattern often try, without success, to make speed by using only half of the fixture, and only one hand at a time. But once they have learned to use balanced motions, they can produce 50% more work with less effort and fatigue.

1. **Get Two Female Parts**

2. **Place Female Parts on Fixture**

3. **Get Two Male Parts**

4. **Place Male Parts in Fixture**



CAN I ELIMINATE THAT BOARDING HOUSE REACH?

YES ☐

NO ☐

Motions should be as short and as easy as it is possible to make them.

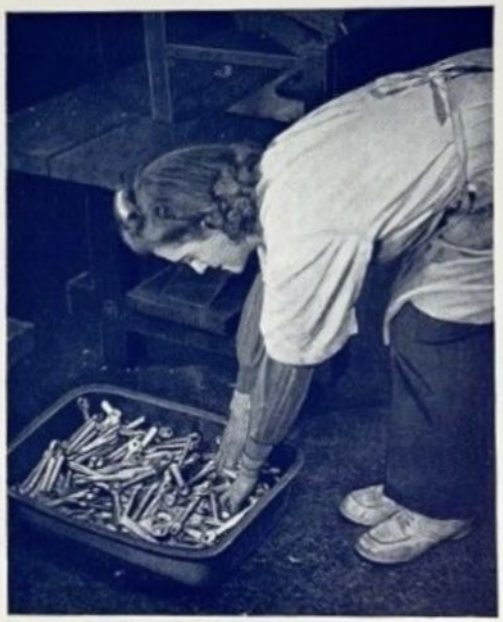
The placing of our materials within the easiest possible reach is not only good etiquette at the dining table, but on the job it will make the difference between finishing the day with a stiff neck and aching back, or of going home with pep left to take in a show after supper.

There are five motion classifications — representing motions of: (1) Fingers; (2) Fingers and wrist; (3) Fingers, wrist, and elbow; (4) Fingers, wrist, elbow, and shoulder; (5) Body and trunk. Finger motions are less tiring than wrist motions; wrist motions are easier than those of the elbow or the shoulder; and shoulder movements are far better than the back-breaking fifth-class motion of the whole body.

When a tub full of tools is placed beside us at our machine, it is usually possible to get them with a *third-class motion* from the elbow, or at most a *fourth-class motion* from the shoulder. But as the level of the material gets lower in the tub, we have to bend down to get our work. This is one reason why our jobs get harder toward the end of the day. We can speed our production, and save ourselves backaches by placing a supply in a smaller pan in easy reach.

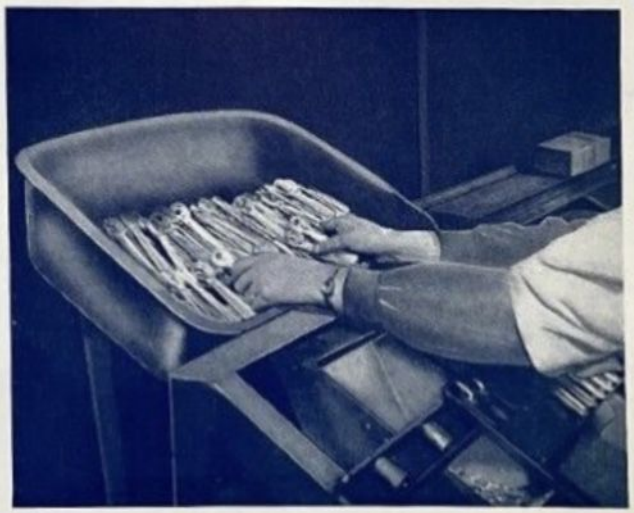
Sometimes we are forced to work the hard way by machines that

were not designed primarily for ease of operation. Examine your machine with these questions in mind: Are all levers and handles in easy reach? Could they be shortened? Lengthened? Bent? Moved to another position?



We can save ourselves backaches . . .

. . . by placing our materials within easy reach.



CAN MY JOB PASS THE NEEDLE-IN-THE-HAYSTACK TEST?

YES ☐

NO ☐

Materials should be kept well separated.

Many jobs are like hunting for a needle in a haystack. On small assembly jobs in particular, where there are a number of small parts, our natural tendency is to spill out a supply in little piles, which, though separated at first, during the course of the day become mixed together. When our materials are kept well separated, the job is easy —but when we must *search* for the right part in a jumbled pile and then *select* one part from many, the job becomes slow and difficult without our realizing it. Our eyes will feel the strain, our head may begin to ache, and we will feel tired all over.

The simple ball and spring assembly, made in the male end of service tools, contains only two parts—but a study of the job showed that operators were spending 20% of their time in handling springs. A simple dispenser which delivers springs a few at a time on a tray covered with white felt for ease of grasp and sight saved half of this handling time with a resulting 10% increase in production.

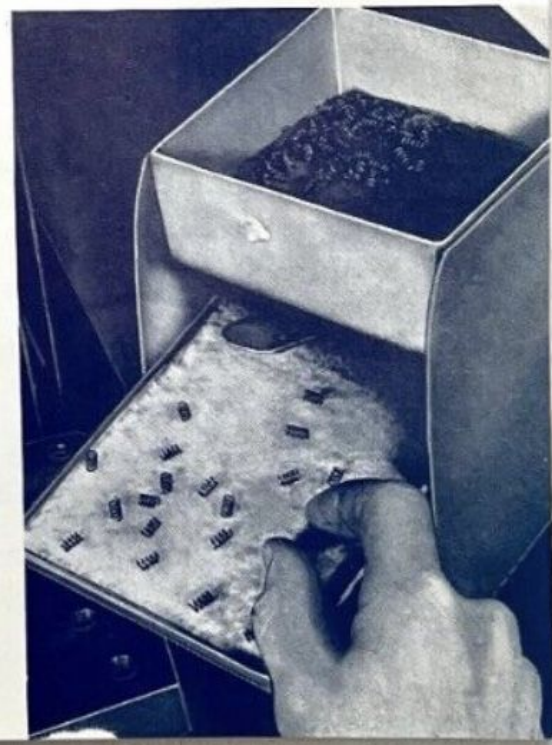
Searching and *Selecting* can be reduced or eliminated on every job by application of these two rules:

(1) *Good Housekeeping at the workplace:* This means keeping tools and materials separated from one another, either in distinct piles, or preferably in separate bins.

(2) *Use of Selecting Devices:* For the small parts which give the most trouble, a dispenser similar to the one in the photograph, or something even simpler should be employed. Sometimes contrasting colors are helpful in aiding visual selection. A rubber finger, a magnet, or a pair of tweezers might do the trick on special jobs.

Production was increased . . .

. . . by a simple dispenser.



ARE MY TOOLS AND MATERIALS PRE-POSITIONED?

YES ☐

NO ☐

Tools and materials should be placed ready for use.

Pre-positioning is a making ready—a preparation for a use to follow. A fountain pen in a desk holder is *pre-positioned*. A fireman tumbling out of bed to answer a three-alarm fire jumps into a *pre-positioned* uniform.

Pre-positioning ties right in with a rule already mentioned: Good housekeeping. All of our tools and materials should have fixed work stations — like a cake of soap in a soap dish over a washbowl. We should, for example, place our screwdriver in a rack instead of laying it flat on the table; or, better yet, we might hang it directly over our assembly jig. All of our tools should be placed as nearly as possible in the position in which they will be used.

Our materials, as well as our tools, should be *pre-positioned* — arranged for immediate use. Some of us may have grumbled at the last operator to work on our job for throwing his work into the pan in a jumbled mess. Which of the two pans of ratchets in the photographs would be the easier to work from? The time spent in stacking the ratchets with all the heads in one direction is saved twice over on the assembly operation.

We should remember that every time we put down a part or a tool we *pre-position* it for the next operation or the next operator. If we pass on our work as we would like to receive it, we increase production on the next operation, as well as on our own. Someday one of us may work out a stacking device to *pre-position* our work for us automatically.

Some of us may have grumbled at the last operator . . .

We should pass on our work as we would like to receive it.

THESE ARE YOUR WEAPONS—the talents of free men to work their utmost with their brains as well as with their hands—and the never-ending search for better ways of building the guns, tanks, ships, planes and tools of war.

CAN MY JOB PASS THE KEYHOLE TEST?

YES ☐

NO ☐

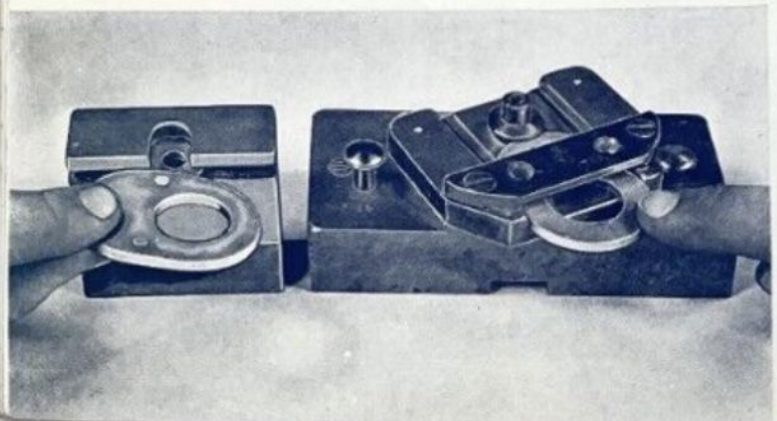
Positioning time should be eliminated.

Sometimes we run across a job that reminds us of a drunk trying to *position* his key in the keyhole.

Since all jigs and fixtures are devices to hold and to *position* our work, we become tool designers when we tackle this problem. There are many simple improvements that we can make.

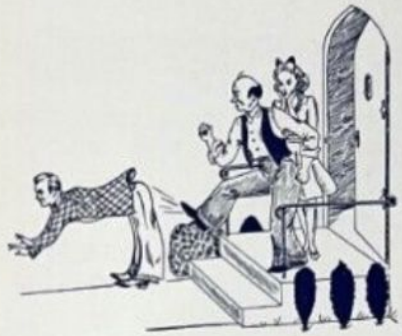
Take a look at the two simple jigs in the photograph. Both were designed to do the job of positioning ratchet covers for a tapping operation, but the old-style jig (left) required almost twice the time of the improved jig (right). The photograph shows why: After the first hole was tapped in the old-style jig, it was necessary to remove the part, to turn it around, and to position it a second time. But in the new-style jig, a simple *first-class* finger motion slides the cover into position against a stop in a fraction of the time it took just to remove the cover from the old jig. This jig was made in a few hours; but its saving per year is equivalent to one more worker working steadily for three months!

Ask these questions about the tooling and the set-up of your job: Can sharp corners be rounded without damaging the accuracy of the jig? Could you use a guide, stop, pilot, gauge or locating pin to reduce positioning time?



Tapping jigs — old style (left) and new style (right).

DOES MY TOOLING HAVE EJECTORS AND QUICK-ACTING CLAMPS?



YES ☐

NO ☐

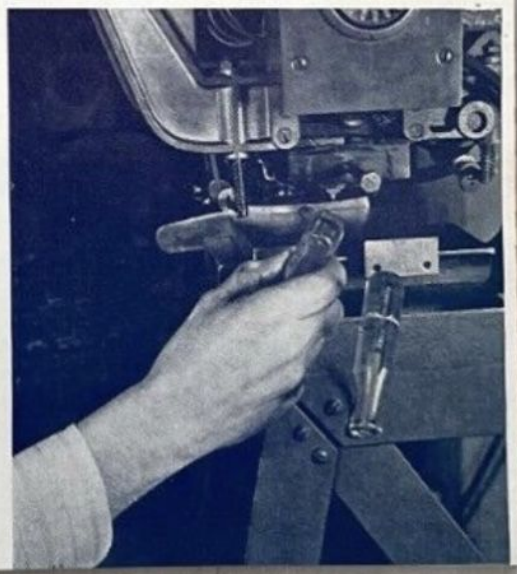
Ejectors and quick-acting clamps reduce non-productive time before and after the operation.

Any job that we do may be divided roughly into four parts: (1) *Get;* (2) *Make ready;* (3) *Do;* (4) *Dispose.* Only the third element — *Do* — represents productive time. Time saved on the other three elements means more time for production.

The second element, *Make ready;* and the fourth, *Dispose,* often may be reduced, or almost eliminated, by quick-acting clamps and by ejectors on our tooling. Time spent in screwing tight a part in a drill jig can be saved by a simple cam or toggle-actuated clamp. An air chuck or vise will often increase production by 20%—simply by reducing the time and effort of *Make ready.*

Another 20% increase in production is often made possible by the use of ejectors. Drill jigs may be frequently improved by adding a knock-out to remove a part jammed by drill bur. Still better are automatic ejectors—perhaps a small air cylinder with a plunger to eject the part as soon as the operation has been completed.

The photograph shows an ejector in actual operation. The camera has caught in mid-air a pyroxolin screwdriver handle being ejected from a marking machine as the next handle is brought into position. This simple spring ejector increased production on this job by 20%.



WOULD A FOOT PEDAL FREE ONE ARM FOR MORE USEFUL WORK?

YES ☐

NO ☐

The hands should be relieved of all work that can be performed by the feet.

When Henry Ford moved the accelerator from steering post to the floor, it was a boon to one-armed drivers.

Like *drop delivery,* foot pedals may be used on a wide variety of jobs. They may be used for holding devices, operating clamps, chucks, or collets; or they may be used to operate feeds. In many cases, the addition of a foot pedal to a machine will result in a 50% increase in production by freeing one hand.

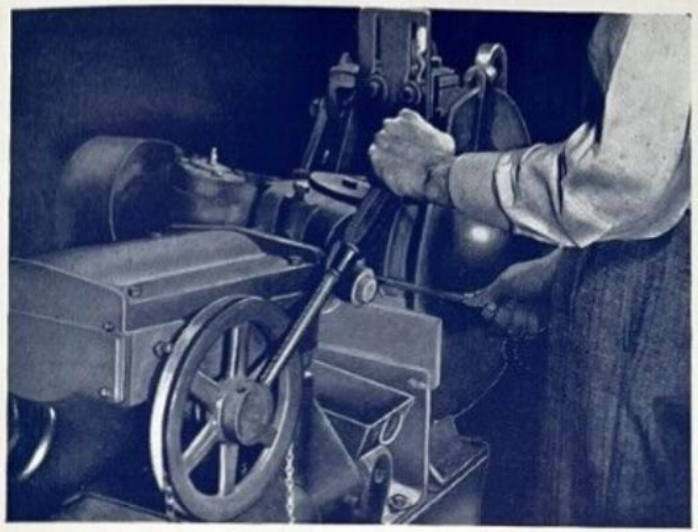
Many machines are equipped with foot pedals as a matter of course. The hammers, upsetters, and trim presses in the Forge, and the punch presses, broaches, and markers in the Machine Shop are some examples. Other machines, not originally equipped with foot pedals, have shown startling production gains when this simple improvement was made.

On the grinding line the addition of a simple foot-operated "pusher" on one of the machines speeded the grinding of hammers. When foot pedals were added to the centerless grinders, production on these machines was increased by hundreds of extra man-hours. These photographs show why:

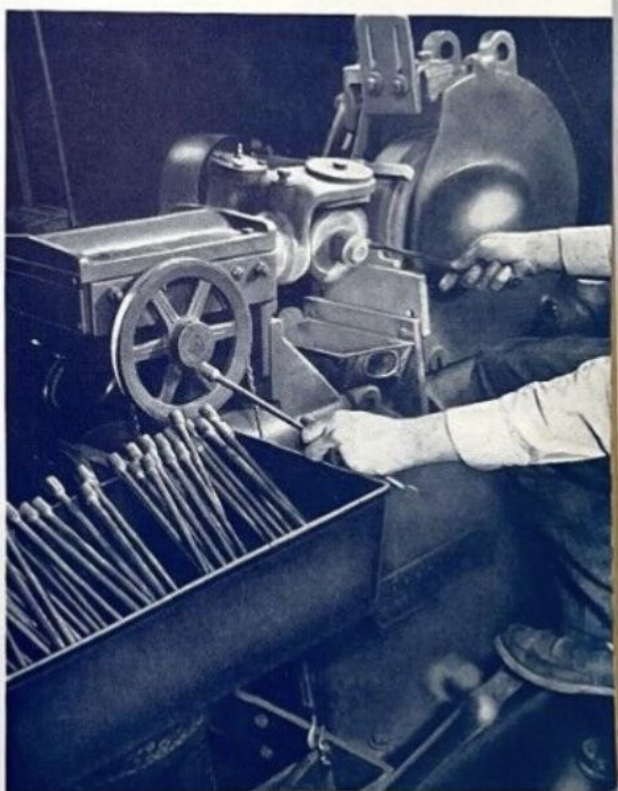
The fatiguing *fourth-class* shoulder motion of the first photograph was eliminated by the addition of a simple foot pedal, which does the same work. Now, sit-down operation of the machine is possible. Furthermore, the left arm is now freed of the necessity of holding. and can have the next tool ready without delay as soon as the operator has completed the part in the machine.

Ask these questions of your job:

Would a foot-operated feed be less tiring? Would it allow me to have the next part ready without delay? Would a foot-operated clamp free one hand for productive work?



This arm was freed for more useful work . . .



. . . by a foot pedal which increased production by hundreds of hours.

CAN I PRODUCE TWO OR MORE AT ONE TIME?

Yes ☐

No ☐

Wherever possible, two or more parts should be made in one operation.

Few of us can do as well as the Dionnes in the matter of extra production—but we can often double our output by making two or more parts in one operation. Gang milling is familiar to us all. Gang grinding, too, is good shop practice. In heat treating, or sandblasting, hundreds of tools are treated at one time.

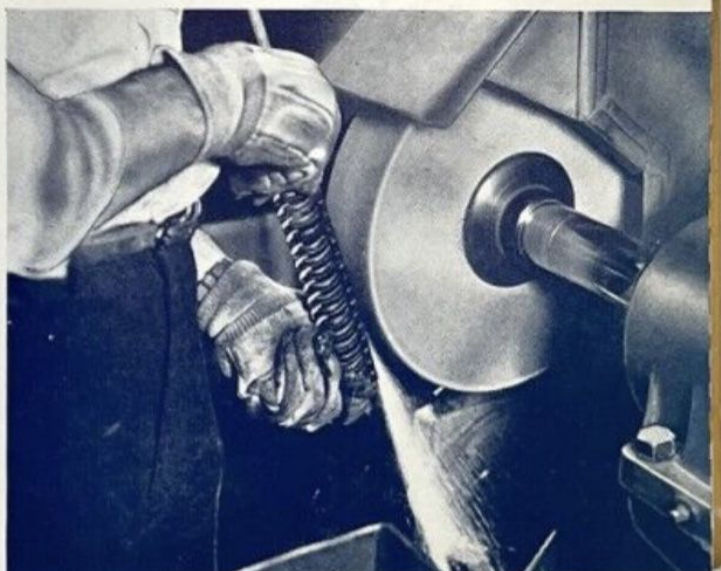
The same principle can be applied to other machines with startling production gains. Ignition wrenches are commonly broached three at a time. Some parts are regularly forged two or more at a time; and drilling jobs, too, can be doubled up. On our Extension Line a two-spindle drill press with semi-automatic air-feed drills two extensions at once. Small assembly jobs, too, can often be done in tandem by using balanced motions, like the assembly of universals pictured on page 11.

An outstanding example of doing many parts at once is the job of polishing the edges of crowfoot wrenches. At one time each piece was held in the hand and polished separately. *One at a time was all that could be done when the hand was used as a holding device.* Then it occurred to one alert worker that he could increase his output by

putting a dozen or more on a rod, or "spinner," and polishing them together. The result: Production on this job doubled, and another three months of one man's production were added to the year.

The hands could hold only one at a time.

It occurred to one worker that he could double his production . . .



CAN MY OPERATION BE COMBINED WITH ANOTHER?

Yes ☐

No ☐

It is sometimes advantageous to combine two or more operations into one to save handling time.

A one-man band can't tackle a symphony, but we can sometimes kill two birds with one stone, by applying his principle of combination of operations. In the Forge Shop, for example, it is often found advantageous to combine a trimming operation with the forging operation, by trimming the forgings while they are still hot. Wear on the trimming dies is reduced and time is saved. In the Machine Shop the most striking example of combining operations is seen on the Automatic Screw Machines. On these machines, sockets are formed, drilled, grooved, countersunk, and cut off in one operation.

On the grinding line there is now in use a jig which by combining operations has increased production 25%. The jobs are: Grinding screwdriver blades square, grinding the edges, and grinding the flats. These jobs once required three separate set-ups, three operations and three handlings. By combining all three operations in one set-up, two handlings have been eliminated. The result of this simple change was to add six more months of production to the year.

Ask yourself: Could I do the previous operation, or the following operation along with my present job?

By Combining These Three Operations, Two Handlings Were Eliminated:

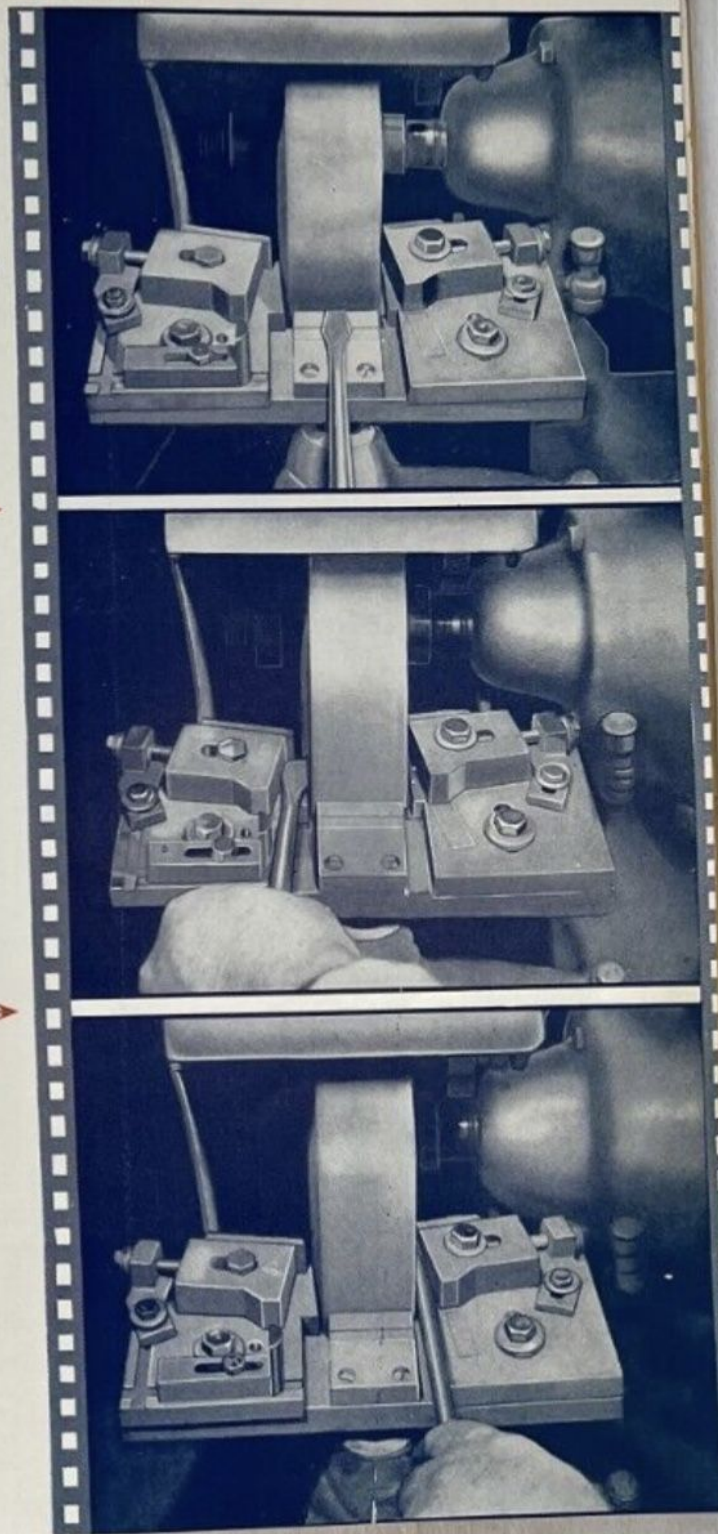
1. Grinding Screwdriver Blade Square

One Handling Eliminated Here →

2. Grinding Blade Edges

Second Handling Eliminated Here →

3. Grinding Blade Flats



Investigation

After you have turned in your suggestion, the investigator will get in touch with you within a few days to talk over your idea with you and to clear up any points that may need explanation. He will then discuss your improvement (without revealing your identity) with the supervision concerned and with the Methods Department. After the feasibility of the suggestion has been determined, the investigator will gather the necessary time study data, cost and sales figures, and an estimate of the installation cost. This data, with your suggestion, will then be turned over to the Suggestion Committee for final action. As soon as an award is made, you will be notified immediately.

Win The War!
Start The
Money Rolling
Your Way
With Ideas
That May Help

PLOMB TOOL COMPANY

SUGGESTION BLANK

Keep Your Eyes Open for Ideas
Little Things may be Important

ARE YOU
DOING YOUR
JOB IN THE
ONE BEST
WAY?

HELP YOUR COUNTRY · YOUR COMPANY AND YOURSELF!

THIS SUGGESTION CONCERNS—

Tool Description and Number:_____

Machine Number:_____ Jig or Fixture Number:_____

Operation Description:_____

Other:_____

I SUGGEST:_____

MY SUGGESTION WILL MAKE THE FOLLOWING IMPROVEMENT:_____

MY SUGGESTION CAN BE PUT INTO EFFECT AS FOLLOWS:_____

Suggestion No.

MAKE SKETCH ON OTHER SIDE OF SUGGESTION BLANK

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